APPLICATION OF HYDROGEN FOR RECEPTION OF LOW-DENSITY ALLOYS WITH A SMALL THERMAL DILATATION

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Perspectivity of application of alloys of system Al-Si is known in the field of making low-density alloys with small linear expansion coefficient (KLR). A main hindrance to broad application of alloys Al-Si with the major contents of silicium is the availability in their structure of large and very friable stressings a silica phase. In this connection a major series of works where application of different expedients of preparation of mix material, machining of a melt and a crystallization, incrementing the contents of hydrogen is shown, that is lead, allows to receive diminution of quantity and the sizes of stressings of a silica phase [1]. It, in turn, ensures an opportunity of a cold flowage of hypereutectic silumins with a major degree of work hardening. In linkage with fixed existence of close connection between quantity KLR and the contents of hydrogen mining of the high-silicon alloys hydrogen-containing as an alloying element is lead. For reaching an object in view the wrought alloy on a ground of the aluminium, containing silicium which differs from all known alloys that designed, that it follow-up contains hydrogen at following components ratio, mass %:
Silicium 15-20
Hydrogen 0,00134-0,00259
Aluminium remaining [2].

Introduction in makeup of hydrogen in predetermined thresholds (0,00134-0,00259 mass %), that fit with 15-29 sm^3 / 100 g of an alloy, promotes sharp fine crushing of primary stressings of silicium and improves ability of an alloy to a cold flowage. At a flowage the part of hydrogen transfers in aluminium, forming with it a solid solution of a heading, that, in turn gives in decrease of a linear expansion coefficient and pinch of mechanical characteristics of an alloy. In table 1 properties designed and the known alloys magniterous and copper are given.

Table 1. Chemical composition and a linear expansion coefficient of alloys Al-Si-H

Makeup of an alloy, % (Al– the rest)	$\alpha \cdot 10^6$ °C^{-1} over the range test temperatures, °C		
	20–100	100–150	150–200
15 Si – 0,00259 H	13,6	5,9	5,0
17 Si – 0,00193 H	12,5	6,2	5,7
18 Si – 0,00170 H	11,1	4,6	7,2
20 Si – 0,00134 H	10,6	3,3	5,1
20 Si – 0,5 Mg –2,9Cu	17,2	17,9	18,2
20 Si–1,8 Mg	16,0	16,9	17,1

Introduction in makeup of alloys Al-Si-H of small additives of elements, which differ a high affinity to hydrogen (titanium, a nickel), ensures major saturation coefficient at hydrogenation a melt. In result at a crystallization even more shallow stressings a silica phase that ensures, accordingly, still a major degree of a flowage are formed.
In table 2 chemical composition of alloy Al-Si-Ti-Ni-H given.

Table 2 - Chemical composition of designed alloys Al-Si-Ti-Ni-H

№ an alloy	The contents of builders, mass % (Al– the rest)			
	Si	Ti	Ni	H
1	14	0,03	0,35	0,00117
2	15	0,4	0,6	0,00207
3	18	0,2	0,8	0,00162
4	20	0,05	0,4	0,00270
5	21	0,6	1,0	0,00324

Final outputs by definition mechanical characteristics and a linear expansion coefficient show, that an alloy building of hypereutectic silumins hydrogen together with "elements - pumps" (table 3) [3] allows to receive rather high mechanical characteristics in a combination to a small thermal dilatation.

Table 3 - Chemical composition, mechanical characteristics and a linear expansion coefficient of alloys Al-Si-Ti-Ni-H

Makeup of an alloy, % (Al- the rest)	$\sigma_в$, МПа	δ,%	$\alpha \cdot 10^6$ °C^{-1} over the range test temperatures, °C		
			20-100	100-150	150-200
14Si-0,3Ti-0,3Ni-0,00117 H	224	2,0	13,7	6,1	5,2
15Si-0,4Ti-0,6Ni-0,00207 H	275	3,6	13,3	5,9	4,9
18Si-0,2Ti-0,8Ni-0,00162 H	290	3,0	11,6	5,9	4,2
20Si-0,5Ti-0,4Ni-0,00270 H	267	3,2	10,7	4,0	4,3
21Si-0,6Ti-1,0Ni-0,00324 H	143	0,9	10,6	3,4	4,1
15÷20Si-0,00134÷0,00259 H	194-241	1,6-2,3	10,6-13,6	3,3-5,9	4,9-5,1

Reduced results allow to make the inference, that hard-wrought alloys Al-Si-H can become worthy replacement expensive спеченных aluminum alloys [4].

References

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